Attachment G

Noise Impact Assessment Technical memorandum (2017)

Memo

Date: Tuesday, February 20, 2018

Project: Skookumchuck Wind Energy

To: Theresa Webber (RES), Sean Bell (RES)

From: Adam Buck and Tim Casey

Subject: Noise Impact Assessment Technical Memorandum

The proposed project would construct and operate a wind energy generation facility with an anticipated rated capacity of approximately 137 megawatts. The project lease area spans approximately 19,650 acres in Lewis and Thurston counties in the State of Washington. A project substation would be constructed in the area of the turbine string. The project would also construct a 15-mile-long generator tie line, an interconnect to the existing Tono Substation, and an O&M facility. This technical memorandum describes the noise impact assessment for the project.

Noise Concepts

Sound is made up of tiny fluctuations in air pressure. Sound is characterized by its amplitude (how loud it is), frequency (or pitch), and duration. Sound, within the range of human hearing, can vary in amplitude by over one million units. Therefore a logarithmic scale, known as the decibel (dB) scale, is used to quantify sound intensity and to compress the scale to a more manageable range. Noise is simply defined as unwanted sound; the terms noise and sound are often used interchangeably.

The human ear does not hear all frequencies equally. In fact, the human hearing organs of the inner ear deemphasize low and very high frequencies. The most common weighting scale used to reflect this selective sensitivity of human hearing is the A-weighted sound level (dBA). The range of human hearing extends from approximately 3 dBA to around 140 dBA (all sound pressure levels in this report are relative to 20 micropascals).

Most sounds are made up of a wide range of frequencies, and are termed broadband sounds. Sounds that are focused in a particular frequency range are tonal sounds. Sound sources can be constant or time-varying. Environmental sound levels are often expressed over periods of time, allowing time-varying signals to be represented by sound levels averaged over intervals (for example, a one-hour period). One metric used to describe environmental sound is the equivalent average sound level (L_{eq}). The L_{eq} represents a constant sound that, over the specified time period, has the same acoustic energy as the time-varying signal.

Noise Regulations

Construction and operation of the proposed project would be subject to the noise regulations of the State of Washington, Lewis County, and Thurston County. The Lewis County Code (Section 17.145.050) references the State of Washington noise emission limits (WAC 173-60) for their local limits. The Thurston County Code also references the state noise emission standards (Chapter 10.36).

The State of Washington noise codes (WAC 173-60) provide an exemption for construction activities that occur during daytime hours (7:00 AM to 10:00 PM). As noted above, the Lewis County Code references WAC 173-60 for their local limits; therefore, daytime construction noise is exempt in Lewis County. Additionally, the Thurston County Code (Chapter 10.36) exempts construction noise during daytime hours (7:00 AM to 10:00 PM).

For operations, WAC 173-60 has established environmental noise limits based on the Environmental Designation for Noise Abatement (EDNA) of the property that contains the noise source and the receiving property. Table 1 summarizes the WAC 173-60 limits which say: No person shall cause or permit noise to intrude into the property of another person which noise exceeds the maximum permissible noise levels set forth below in this section. In this manner, these noise limits regulate sound intrusion (sound from a noise source traveling to a noise receiver). These are not all-inclusive, overall noise limits. Rather, they limit the noise from a specific source when it is received on a different parcel; therefore, noise modeling is an appropriate way to evaluate the compliance status of noise sources that do not exist yet.

Table 1. State of Washington Environmental Noise Limits

EDNA of Noise Source	Noise Limit by EDNA of Receiving Property, dBA			
	Class A Daytime	Class A Nighttime	Class B	Class C
Class A	55	45	57	60
Class B	57	47	60	65
Class C	60	50	65	70

Source: Washington Administrative Code (2000), Chapter 173-60, "Maximum Environmental Noise Levels"
Notes:
EDNA Class A = Lands where people reside and sleep (e.g., residences, hospitals, and campgrounds)
EDNA Class B = Lands involving uses requiring protection against noise interference with speech (e.g., commercial, retail, office, educational, and religious buildings)
EDNA Class C = Lands involving economic activities of a nature that have noise levels higher than those experienced in other areas (e.g., warehouse, industrial, agricultural, and silvicultural)
Daytime = 7:00 AM to 10:00 PM
Nighttime = 10:00 PM to 7:00 AM

At any hour of the day or night the applicable noise limitations in Table 1 may be exceeded for any receiving property by no more than:

- 5 dBA for a total of 15 minutes in any one-hour period
- 10 dBA for a total of 5 minutes in any one-hour period
- 15 dBA for a total of 1.5 minutes in any one-hour period.

Lands with project turbines (the primary noise source) are considered EDNA Class C.

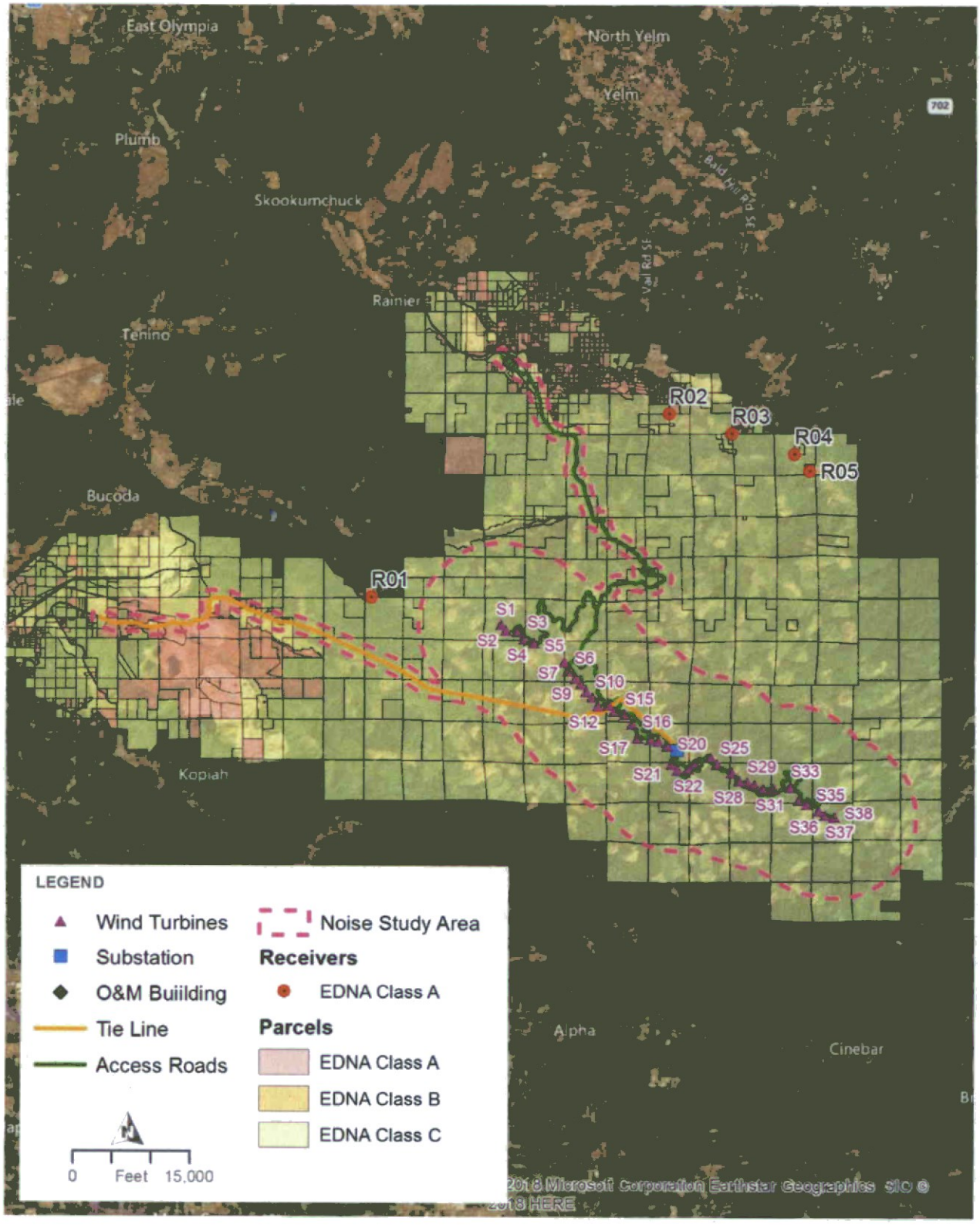
Existing Noise Environment

The noise study area is the area within 2 miles of the proposed turbine locations and the area within 1,000 feet of construction areas (see Figure 1 below). The construction areas include the wind turbine sites, access roads, project substation (located near turbine S20), generator tie line, interconnect to the existing Tono substation (at the west end of the tie line), and O&M facility.

The EDNA classes shown in Figure 1 were based on land use data for Lewis and Thurston counties. Residential, recreational, camping, and park land uses were identified as EDNA Class A. Commercial and governmental land uses were identified as EDNA Class B. Forest land, manufacturing, transportation infrastructure, utilities, and mining land uses were identified as EDNA class C. A rural residential neighborhood is located north of the proposed turbine locations and near the O&M facility; however, the vast majority of the noise study area is more remote. Background noise levels are always fluctuating, but rural residential areas typically experience daytime noise levels of 40 dBA and nighttime noise levels of 34 dBA (ANSI/ASA S12.9-2013/Part 3). In more remote areas, noise levels could at times drop below 30 dBA, or even lower.

Figure 1 also shows modeled receivers, which are discussed further below.

Figure 1. Noise Study Area



Noise Impact Assessment Methods

Construction

Construction would occur at the wind turbine sites, access roads, project substation, generator tie line, interconnect to the existing Tono Substation, and O&M facility. The exact construction equipment that would be used on the proposed project is unknown at this time. Table 2 contains construction noise levels for equipment that could be used on this project at distances of 50, 200, 500, and 1,000 feet from the centroid of a construction site.

Table 2. Typical Construction Noise Levels

Construction Activity	Construction Equipment	Usage Factor, %	L_{max} at 50 ft, dBA	Hourly L_{eq} at 50 ft, dBA	Activity Total Hourly L_{eq} at Distance (ft), dBA			
					50	200	500	1,000
Blasting	N/A	5	94	81	81	69	61	55
Site Preparation	Dozer	40	85	81	82	70	62	56
	Compactor	20	80	73				
Foundation	Dozer	40	85	81	85	73	65	59
	Concrete Mixer Truck	40	85	81				
	Concrete Pump Truck	20	82	75				
Erection	Crane	16	85	77	83	71	63	57
	Man Lift	20	85	78				
	Flat Bed Truck	40	84	80				

Source: U.S. Department of Transportation (2006), "FHWA Highway Construction Noise Handbook"
Notes:
Usage Factor = percentage of time that the equipment is in use
L_{max} = maximum sound level

The construction noise levels shown above were calculated assuming free field conditions, which represents an environment that is free from obstructions that could affect the way sound travels away from the noise source. These assumptions therefore result in conservative over-estimates of the noise levels that may be experienced by receptors in the vicinity of the construction activities. Areas shielded by terrain or other features could receive lower noise levels. Furthermore, construction noise is temporary in nature and, as a result of applicable State and County regulations, construction noise is exempt from regulation if it occurs during daytime hours. This noise assessment assumes that construction activities would be limited to daytime hours (for practical purposes).

Operation

Noise from the proposed wind turbines was modeled using the environmental noise analysis program Cadna-A. Cadna-A is based on ISO 9613, "Attenuation of Sound during Propagation Outdoors." Table 3 summarizes the noise model parameters.

Table 3. Noise Model Parameters

Parameter	Model Approach
Noise Emissions	Wind turbines were modeled using sound power levels provided by Vestas.
Terrain	Onsite terrain was modeled using publically available 30-meter elevation contours.
Buildings	There are few buildings in the area of the wind turbines, so shielding structures were not included in the model.
Ground Factor	All ground was modeled as 50% absorptive. This value is considered conservative because the area is primarily soft ground; however, the modeled value accounts for other ground conditions, such as icy snow cover in the winter months.
Meteorology	A site-specific wind rose was not included, resulting in conservative downwind noise levels in each direction – at each modeled receiver.
Temperature and Relative Humidity	The modeled temperature of 10 degrees Celsius and relative humidity of 90% generally matched annual average values for the area (Climate Zone 2017).

The wind turbines were modeled as point sources at a height of 82 meters, which is the hub height. The proposed project is considering two wind turbine models: the Vestas V136-3.45 MW and the Vestas V136-3.6 MW. In addition to the different models and product options, wind turbine noise emissions depend on the wind speed. Therefore, the loudest noise emissions across the wind turbine models and wind speeds were modeled; this results in conservatively high modeling results and accounts for the reasonably foreseeable conditions. Table 4 contains the modeled wind turbine noise emissions.

Table 4. Modeled Wind Turbine Noise Emissions

Sound Power Level by Octave Band (Hz), dBL (re 1 picowatt)								
31.5	63	125	250	500	1,000	2,000	4,000	8,000
82.3	87.4	95.4	98.1	101.9	105.0	103.3	93.6	78.2
Source: Vestas "Performance Specification V136-3.45 MW 50/60 Hz (Low HH)," "V136-3.45 MW Third octave noise emission," "Performance Specification V136-3.60 MW 50/60 Hz (Low HH)," and "V136-3.6 MW Third octave noise emission"								

Project-related noise levels (meaning only the proposed wind turbines were modeled) were calculated throughout a Cartesian coordinate grid to develop noise contours; proposed wind turbine noise levels were also calculated at specific receiver points. The receiver points are representative of EDNA Class A receptors. The resulting noise contours represent project-related noise levels over areas of equal loudness; areas with the same color contour are

predicted to experience similar noise levels. The noise contours show the calculated A-weighted L_{eq}.

For this project, potentially significant adverse noise impacts are defined as modeled wind turbine noise levels that exceed the environmental noise limits of Table 1.

Noise Impact Assessment Results

Construction

Project-related construction equipment would operate in any given area for a limited period of time. The transitory, localized, and finite nature of construction activities reduces the potential for noise impacts. Project-related construction activities would occur during daytime hours; therefore, project construction would be exempt from the local noise regulations. Potentially significant adverse noise impacts are not anticipated during construction.

While mitigation measures are not required, the following measures are best practices that should be considered for reducing construction noise:

- Use the quietest available construction equipment and techniques
- Ensure equipment is properly maintained
- Limit vehicle trips near noise-sensitive receptors
- Limit vehicle idling

Operation

The generator tie line and interconnect to the existing Tono Substation have the potential to generate corona noise. Corona noise is a minor noise source and is unlikely to exceed the limits of Table 1. Therefore, changes in the generator tie line alignment have not changed the results of the noise assessment. The O&M facility is proposed to be constructed near the existing Weyerhaeuser Vail office and is not anticipated to contain major noise sources.

Appendix A contains the modeled noise contours for the wind turbines. Table 5 summarizes the modeled results at the modeled receivers.

Table 5. Modeled Results at Receivers

Receiver	EDNA Class	Limit (Daytime / Nighttime), dBA	Nearest Turbine	Distance to Nearest Turbine, miles	Modeled Noise Level, dBA	Potential for Impact?
R01	A	60 / 50	S1	3.2	< 20	No
R02	A	60 / 50	S3	6.5	< 20	No
R03	A	60 / 50	S6	6.9	< 20	No
R04	A	60 / 50	S6	7.6	< 20	No
R05	A	60 / 50	S25	7.4	< 20	No

Modeling results show that project-related noise levels at the nearest receivers are projected to comply with the local noise regulations.

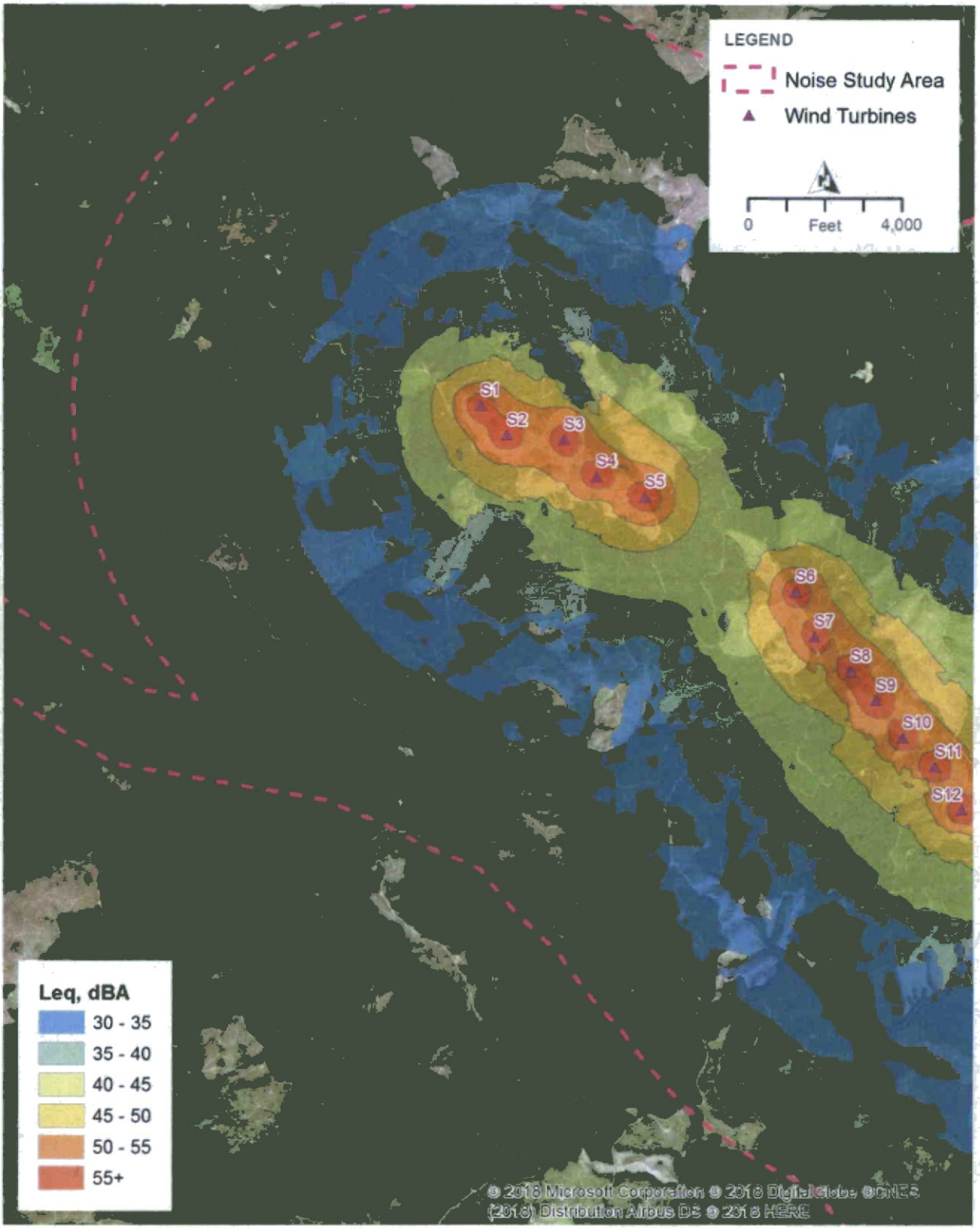
The wind turbines occupy a relatively small percentage of an area that is accessible to recreationalists. Recreationalists would be in the area for a temporary period of time, and would not be allowed to camp in direct vicinity of the turbines. Noise from the wind turbines is unlikely to cause a significant adverse impact to the recreational quality of the area.

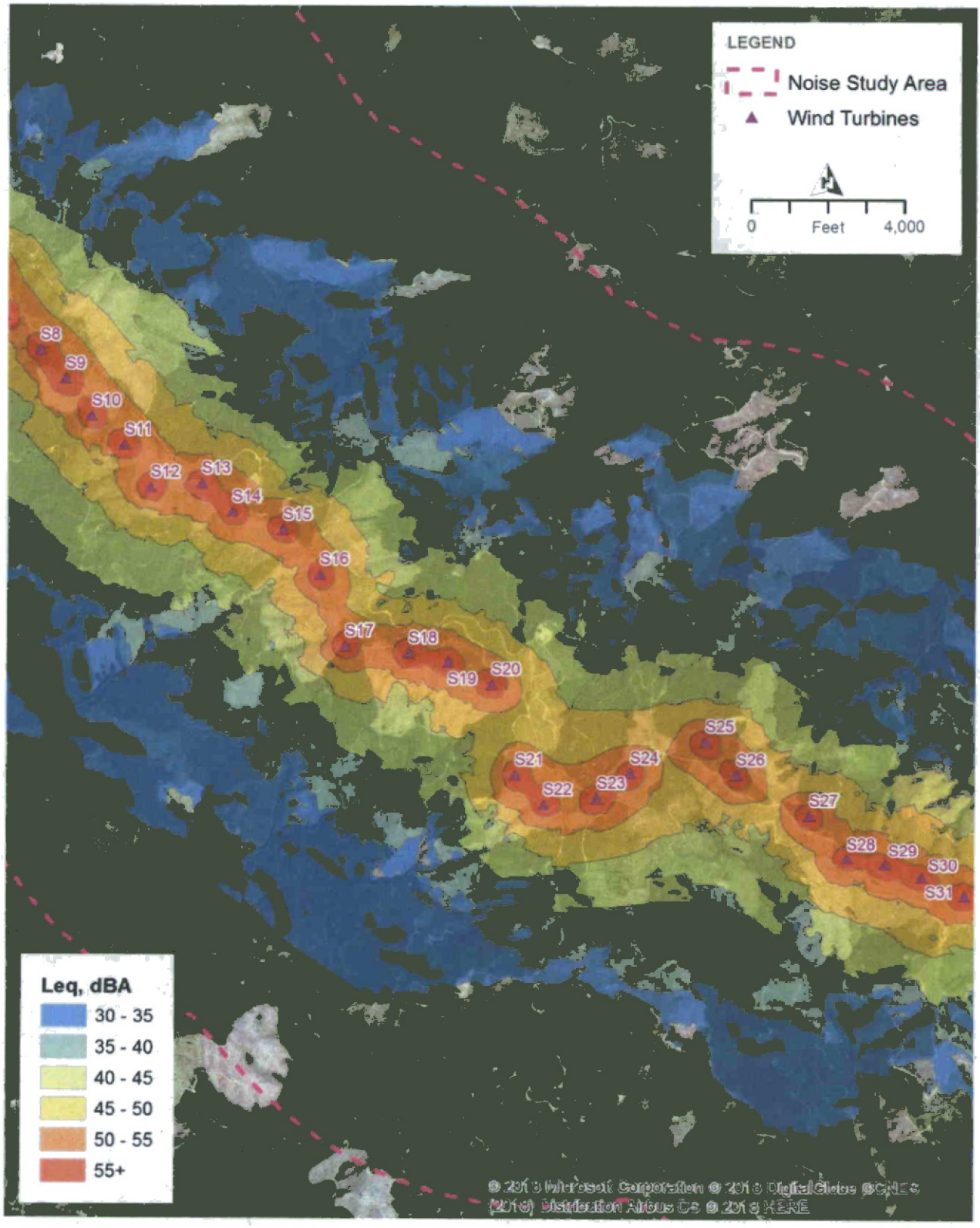
All modeled wind turbine noise levels are below the applicable environmental noise limits for each receiver. Therefore, potentially significant adverse noise impacts are not anticipated during operations.

Conclusions

The proposed project would introduce temporary construction noise and long-term wind turbine noise to the existing noise environment. Construction would occur during daytime hours for a finite period of time. Modeled wind turbine operations noise levels were below the environmental noise limits for the area. Therefore, potentially significant adverse noise impacts are not predicted, and mitigation measures are not required.

Appendix A – Modeled Noise Contours





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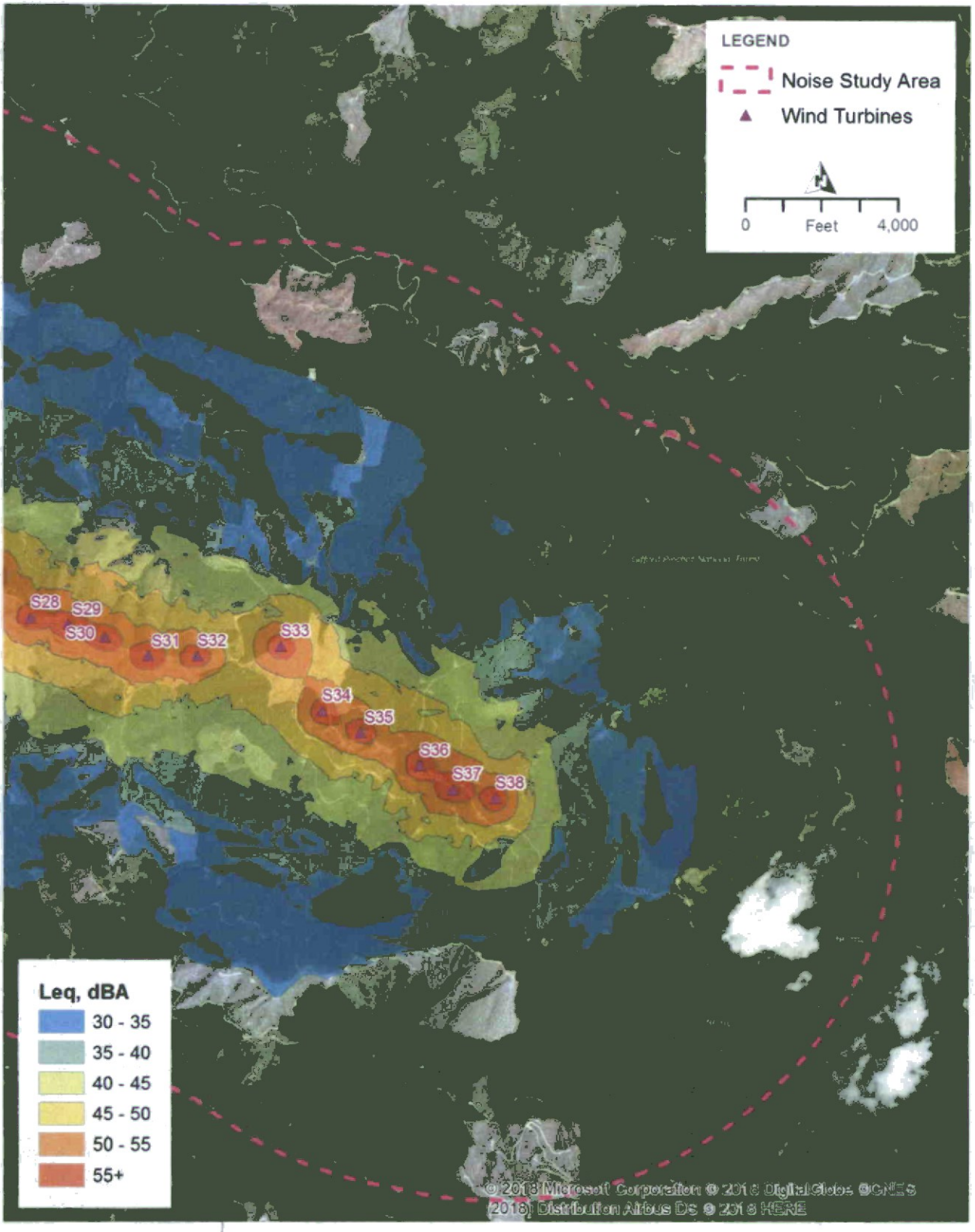
LEGEND
Noise Study Area
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Feet
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S28
S29
S30
S31
S32
S33
S34
S35
S36
S37
S38
Leq, dBA
30 - 35
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